The Impact of Declining Vaccination Rates for Children Entering School in Utah

The Community Vaccine Forum

Utah Citizens' Counsel, Promise Partnership Utah, Voices for Utah Children, Utah Medical Association, Utah Chapter of the American Academy of Pediatrics, Utah Department of Health and Human Services

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INTRODUCTION

Vaccination coverage among Utah children entering kindergarten has declined for several years. To address this concern, the Utah Citizens' Counsel[1], in cooperation with Promise Partnership Utah[2] and Voices for Utah Children[3], established a community study forum with the following objectives:

- Encourage responsible and informed discussions about vaccines for children.
- Evaluate whether declining vaccination rates represent a genuine public health concern.
- Generate credible, accurate, and trustworthy information on the benefits and risks of vaccines for children.

Since the study forum was established, the Utah Medical Association, the Utah Department of Health and Human Services, and the Utah Chapter of the American Academy of Pediatrics have become partners in the discussion. Individual participants in The Community Vaccine Forum are included in Appendix A on page 25.

Summary of Findings

Childhood infectious diseases historically exacted an enormous toll in sickness and death. In the 1900s alone, millions of children were infected, and thousands died or were left disabled. The devastation caused by preventable diseases was an ordeal for those who observed and experienced it.	1-4
The development and introduction of vaccines was considered a miracle, preventing millions of illnesses, deaths, and lifelong disabilities while saving billions of dollars in healthcare costs. Vaccines contributed to increasing life expectancy at birth in the United States from 47.5 years in 1900 to 77.5 years in 2022. Much of the success in achieving a highly vaccinated population can be attributed to the elevated vaccination rates among young children, resulting from the school immunization laws.	5-7
Adequate vaccination rates for children entering kindergarten in Utah have significantly declined from approximately 98% in the 2009-2010 school year to 89% in the 2023-2024 school year. Six out of ten Utah schools are below the CDC measles target of 95% for adequate community protection. Four out of ten are below 90% and are likely to experience an outbreak if an infected child enters the school.	7-12
High vaccination rates are essential for community-wide protection against the spread of childhood infectious diseases. The more rates decline the greater the risk. Almost all infected individuals in recent measles outbreaks in the United States were not vaccinated. A measles outbreak in Utah would be catastrophic for the healthcare system.	12-15
Declining community protection is a significant concern for individuals who cannot be vaccinated because they are too young, elderly, are pregnant, or have compromised immune systems due to conditions such as cancer.	11-15
There are risks associated with almost all medical interventions, but while mandated vaccines for school aged children are among the safest, parents have indicated that the main reason for not vaccinating their children is concern about the safety of vaccines.	10
Childhood vaccines have undergone extensive clinical trials for effectiveness and safety before being approved for public use. Childhood vaccines are among the most studied of all medications and have proven consistently over time to be safe. The benefits of vaccines significantly outweigh the risks and are comparable to or even lower than the risks associated with other commonly used medications, such as antibiotics.	15-20
The politicization of the COVID-19 pandemic led to a surge of misinformation and disinformation surrounding vaccines that have affected public attitudes about vaccine safety. Misinformation about the potential long-term effectiveness of childhood vaccines is not supported by credible research or has been discredited. Vaccines do not cause autism or other chronic diseases.	15-20

Should we be concerned about declining vaccination rates for children entering school?

The gravity of infectious diseases and the importance of vaccines in managing them are well documented. Nevertheless, some well-intentioned individuals challenge the notion that declining vaccination levels for children in Utah and other states heighten the potential for a disease epidemic and represent a legitimate public health concern. They question whether the goal of a highly vaccinated population serves the public's best interest and whether achieving this goal improves the well-being of our citizens. These are questions that will be addressed.

HISTORY OF CHILDHOOD INFECTIOUS DISEASES

The history and impact of infectious diseases were not well documented until the 15th century. Alongside this documentation, child mortality rates became a significant concern. Some examples of documentation include:

- Epidemics of smallpox were reported in Massachusetts in the 1600s, leading to a death rate of 20% of the population in Boston.
- Regarding mortality rates, one report stated that "about two-thirds of the children born in London died from infectious diseases before the age of five and that about 75% of deaths occurred before two years of age." During this period, a diphtheria epidemic claimed over 500 lives in colonial America.
- In the 1700s, measles epidemics were reported four times, one of which claimed 900 children in Charleston, South Carolina. Smallpox epidemics were occurring approximately every 20 years.
- In the mid-19th century, poliomyelitis, a devastating and feared disease, began to emerge in epidemics, particularly in developed countries.
- At the beginning of the 20th century, infectious diseases, including influenza, smallpox, measles, diphtheria, and pertussis (also known as whooping cough), were widely prevalent in the United States. They exacted an enormous toll on public health, resulting in significant illness and death.

There were few effective treatments available to prevent infectious diseases. Although the first smallpox vaccine was developed in 1796, its widespread use did not occur until 100 years later. The rapid spread of serious illnesses and deaths raised major public health concerns and considerable anxiety among the general population.

THE DEVASTATION OF INFECTIOUS DISEASES

Table 1
Pre-Vaccine Number of Children Infected by Disease

Disease	Estimated number of children **out of 1000** who were infected by the disease at some point during their childhood in the years before each vaccine was introduced
Smallpox	950
Diphtheria	100
Pertussis	700
Polio	20
Measles	900
Mumps	600
Rubella	200

Source – Elena Conis, Historian of Medicine and Public Health—New York Times, March 2025

Vaccine protection that parents and their children enjoy today is a miracle that those in the past could only dream of. Infectious diseases once emptied towns, devastated economies, and troubled nurses and doctors. The devastation caused by preventable diseases was a nightmare for those who experienced it. **Table 1** summarizes the estimated number of children who fell ill with childhood infectious diseases before vaccines were introduced in the United States.[4]

Smallpox caused fever, headache, nausea, and severe body aches, accompanied by a rash of painful, pus-filled blisters. In the most severe historical cases, the pustules spread so densely that they covered the body, crusted over the eyes, and invaded the mucous membranes until internal bleeding resulted in certain death. A smallpox outbreak could kill up to 30 percent of those infected. Survivors were often left with pockmarked skin and blindness.

Diphtheria cases were recognizable only by the sweet-smelling, putrid membrane of bacteria and decaying cells covering the patient's tonsils and throat. Diphtheria bacteria produce a toxin that can lead to paralysis, but in 19th-century epidemics, sick children often died of suffocation first. In the deadliest outbreaks, 30 to 50 percent of infected children perished.

Pertussis, or whooping cough, often begins like a minor cough or cold. Weeks later, the cough persists, unrelenting. Before the advent of antibiotics or vaccines, the patient's cough would become violent and uncontrollable, culminating in the characteristic "whoop" sound. In young children, the whoop often led to vomiting. In severe cases lasting for weeks, a child might whoop and vomit several times an hour. Babies couldn't take in enough air forcefully to whoop, and the lack of oxygen caused them to turn blue.

Most **polio** infections are minor, causing symptoms such as fever and sore throat. In less than 1 percent of cases, the virus attacks nerve cells in the brain and spinal cord that control movement. Some patients experience partial paralysis (facial paralysis pictured), while others lose the ability to swallow, walk, or breathe properly. In the worst cases, the illness can be fatal.

The first **measles** outbreak in the Americas was so infectious that it spared almost no one. It caused a vivid red rash and fevers that spiked so high and lasted so long that the sick searched desperately for relief from the fire of measles. In populations that had never encountered the virus before, measles could kill up to a quarter of people. In previously exposed populations, it could still kill 20 percent of children. In the mid-20th century United States, overall improvements in nutrition, hygiene, and medical care kept measles death rates low. However, the virus can result in alarming complications, including pneumonia, rare but severe brain inflammation, and a weakened immune system that persists long after the disease is resolved.

Children with **mumps** often experience headaches, loss of appetite, and a low-grade fever. The most well-known sign of mumps is the swelling of the salivary glands, specifically the parotid glands, located below the ear. Before a vaccine was available, mumps accounted for around 10% of viral meningitis cases reported in the US. Up to 10% of post-pubertal males with mumps may experience testicular inflammation, which can involve pain, sterility, swelling, nausea, vomiting, and fever, with tenderness in the area possibly lasting for weeks.

Rubella was not a significant concern for children who showed only mild cold symptoms. However, when contagious children transmit the disease to pregnant women, the fetus faces serious risks. The virus, which typically invades the airways, can reach the placenta and disrupt the rapidly dividing cells of the fetus. Before the vaccine was introduced, rubella infections caused numerous miscarriages and stillbirths. Many children were born with birth defects, including cataracts (pictured), hearing loss, and severe heart and bone deficiencies. In very rare cases, children developed neurological deficits, leading to chronic seizures and physical or intellectual disabilities. The 1964 epidemic affected 20,000 infants.

Images taken from the CDC website and Mayo Clinic

Table 2
The Introduction of Childhood Vaccines & Their Impact on Childhood Infectious Disease Cases in the US

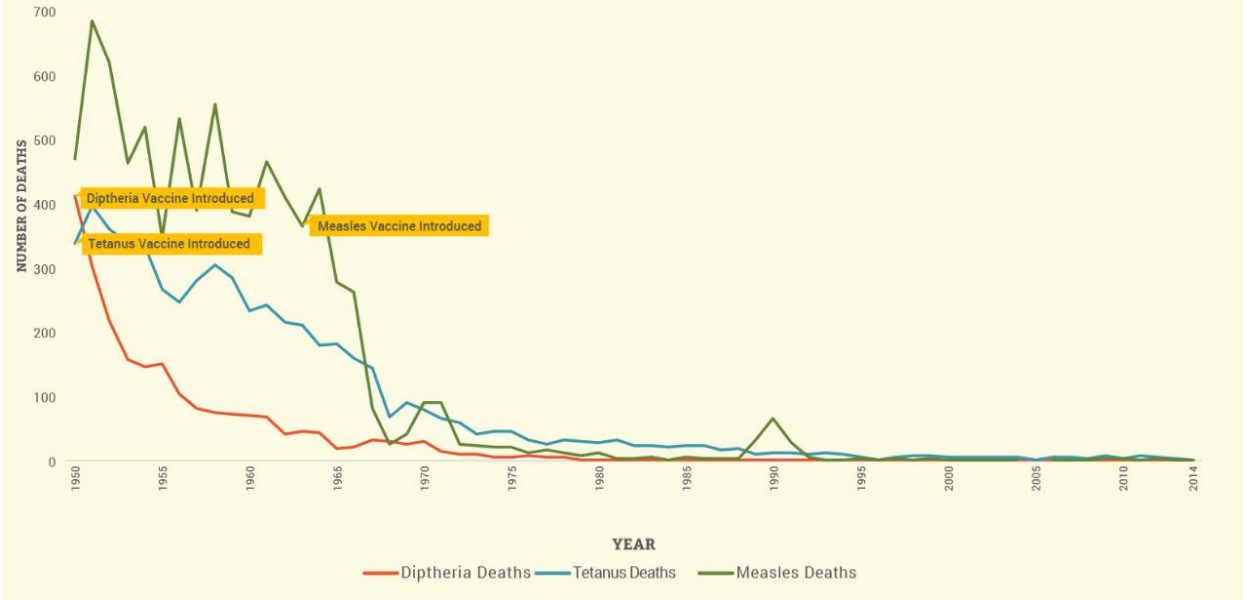
Vaccine	Year Vaccine was Licensed or Introduced	Peak Cases in Pre-Vaccine Era		Number of Cases (2017)	Percent of Children 19-35 Months Who Were Vaccinated (2017)	Percent Reduction in Disease Incidence
		Number	Year			
Measles	1963	763,094	1958	99	****	99.9
Mumps	1967	212,932	1964	6,109	****	97.1
Rubella	1969	20,000	1964-65*	5*	****	100
MMR Combo	1971	NA	NA	NA	91.5	NA
Diphtheria	1923	30,508	1936	0	****	100
Pertussis	1914	265,269	1934	18,987	****	92.8
Tetanus**	1924	601	1948	33	****	94.5
DTaP Combo	1991	NA	NA	NA	94.0	NA
Polio	1955/1961	21,269	1952	0	92.7	100
Smallpox***	1798***	110,672	1920	0	NA***	100

Sources – Centers for Disease Control – Achievements in Public Health and Epidemiology; Prevention of Vaccine Preventable Diseases

**Cases of congenital rubella syndrome occur in newborns in utero when their mothers contract rubella*
***Tetanus cannot be transmitted between individuals*
****Smallpox vaccination was discovered in 1798 but was not widely used until the 1900s. It was eradicated in 1977 as a result of a global vaccination campaign and is no longer used except for research purposes*
*****The Measles, Mumps, and Rubella vaccines were administered as a combination vaccine (MMR) in 2017. The same for Diphtheria, Pertussis, and Tetanus (DTaP).*

Effective vaccines have existed for a long time and have had a dramatic positive impact on childhood infectious diseases in the United States, as shown in **Table 2.** The introduction of vaccines not only significantly affected the number of children who fell ill, but it also reduced the number of deaths, as illustrated in **Figure 1.**

Figure 1
Reported Deaths from Vaccine-Preventable Diseases, United States (1950-2014)



The sharp decline in illness and death following the introduction of vaccines for diseases is remarkable and should not be overlooked. The development and introduction of vaccines have significantly enhanced the quality of life in the United States. For example:

- Smallpox, which has affected humans since 1000 BC, has been successfully eradicated.
- Measles was declared eliminated in 2000[5]. Before the measles vaccine became available in 1963, there were an average of 503,282 cases and 432 deaths each year (mostly among children under 15). On average, 48,000 were hospitalized, and 10,000 developed encephalitis.
- The polio vaccine was licensed in the United States in 1955. In the four years before its release, an average of 16,316 cases and 1,879 deaths were reported each year.
- Before the pertussis vaccine became widely available, as many as 200,000 children were infected, and 9,000 died each year.

A study in Lancet concluded that since 1974, vaccination has averted 154 million deaths, including 146 million among children younger than 5 years, of whom 101 million were infants younger than 1 year.[6] According to the Centers for Disease Control and Prevention, "Among children born from 1994 to 2023 (in the US), routine childhood vaccinations will have prevented approximately 508 million cases of illness, 32 million hospitalizations, and 1,129,000 deaths, resulting in direct savings of $540 billion and societal savings of $2.7 trillion."[7] The average life expectancy at birth in the United States increased from 47 years in 1900 to 77.5 years in 2022.[8] Improved sanitation, clean water, and **a *highly vaccinated population were the primary factors contributing to this increase*.**[9]

How the US Achieved a Highly Vaccinated Population

All 50 states and Washington, D.C., have laws requiring certain vaccines for students to enter school, aimed at increasing protection against childhood infectious diseases.[10] Utah publishes a schedule of required immunizations for entry into childcare settings, kindergarten, and seventh grade, with provisions for medical and personal exemptions[11]. ***Much of the success in achieving a highly vaccinated population can be attributed to the elevated vaccination rates among young children, resulting from the school immunization laws***.[12] [13]

What is the Relationship Between Vaccination Levels and the Potential for Measles Transmission?

This analysis focuses on vaccination rates for children entering kindergarten, with a particular emphasis on measles. This is important because measles is highly contagious, and recent outbreaks in the United States have almost exclusively affected communities with small subsets of unvaccinated individuals. This puts infants, immunocompromised patients, and the elderly at risk. In considering the relationship between vaccination levels for children entering kindergarten and the potential for a measles outbreak, the following guidelines will be used.

1. The Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) have established a Measles, Mumps, and Rubella (MMR) ***vaccination coverage target of 95%***. This level is necessary to maintain adequate community protection when a child with measles arrives in the community.[14] Some academic sources suggest a slightly lower threshold range between 93-94%. This is based on theoretical assumptions of ideal conditions that are not achievable in real-world settings. The CDC MMR target of 95% will therefore be used in this report.

2. When measles vaccination levels for a school **fall to 90%,** the chance of a community outbreak following the arrival of a child with measles rises to 51%. As vaccination levels continue to decline, the likelihood of an outbreak increases sharply.[15] [16](see Table 10). It is noted that risk levels are not linear. Small changes, especially when geographically or socially clustered, can significantly increase the risk potential.

DECLINING VACCINATION LEVELS FOR CHILDREN IN UTAH

Despite the well-documented effectiveness of vaccines in preventing illness and death, routine vaccinations for kindergarten children in the United States have declined.[17] Of greater concern is that the measles vaccination rates for children in Utah have decreased since the 2005-2006 school year, as indicated in **Table 3**, and the decline seems to persist. Vaccination rates for Diphtheria, Tetanus, Pertussis (DTaP), Polio, and Chickenpox have decreased at a similar rate. Current measles vaccination levels are well below the 95% target recommended by the CDC to prevent community transmission.[18]

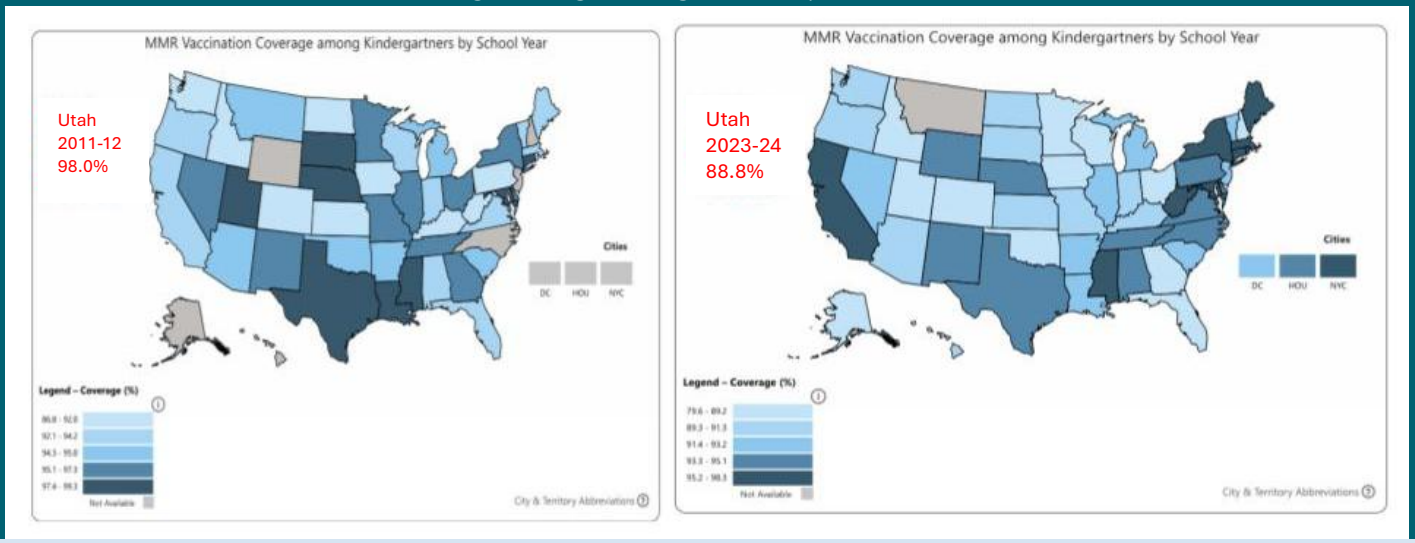
The relative decline in vaccination coverage in Utah compared to other states is further documented in **Figure 2**.

Table 3
MMR Vaccination Rates for Children Entering Kindergarten in Utah by School Year

School Year	Measles, Mumps and Rubella (MMR)	
	Utah	Highest State
2005-2006	98.3%	99.8%
2009-2010	97.7%	100.0%
2015-2016	94.2%	99.4%
2021-2022	90.0%	98.6%
2023-2024	88.8%	98.4%

Source – Centers of Disease Control—Vaccination coverage among children entering school

Figure 2
MMR Vaccination Coverage Among Kindergarteners by State and School Year: 2011-2024



Source – cdc/gov/schoolvaxview/data/index.html

Vaccines help children grow up healthy and flourish, and Utah was once a model for child protection. Over the past twelve years, Utah has shifted from being among the states with the highest level of protection against measles, mumps, and rubella (MMR) to those with the lowest level of protection. Statewide vaccine coverage fell to 88.8% in the 2023-24 school year, significantly below the recommended thresholds needed to prevent outbreaks.[19]

School Districts in Utah & Varying Vaccination Levels

Students entering school in Utah must be vaccinated against diphtheria, tetanus, pertussis, polio, measles, mumps, rubella, hepatitis, and varicella (chickenpox). **Table 4** displays the total number of kindergarten students enrolled by school type, the percentage of kindergarten students by school type, and the vaccination levels for students entering kindergarten by school type[20]. Online schools have significantly lower vaccination rates; however, the number of enrolled students is small, and exposure to other students is virtually non-existent.

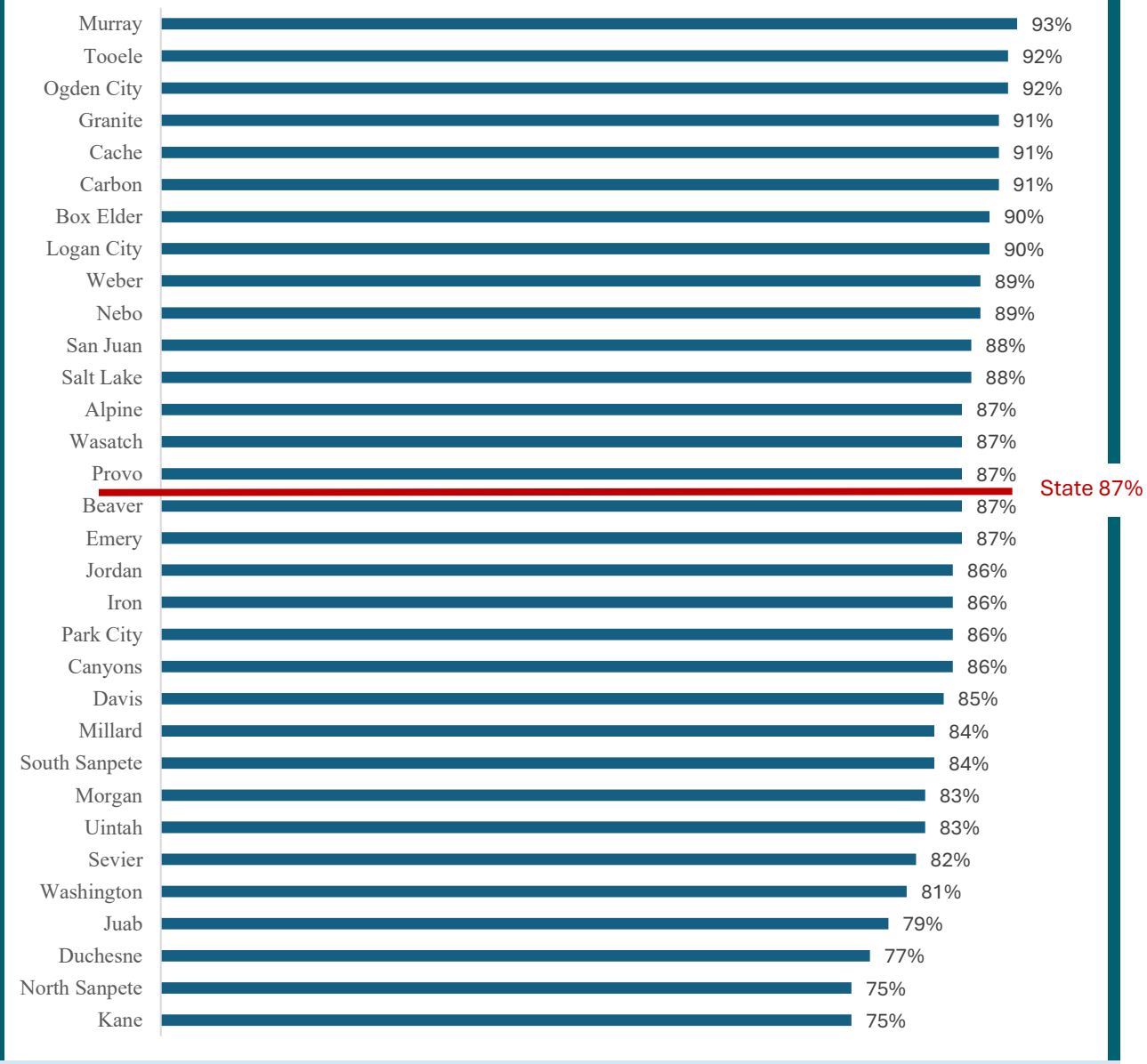
Table 4
Adequately Immunized Students Entering Kindergarten by School Type
School Year 2023-2024

School Type	Total Kindergarten Student Enrollment	Percent of Kindergarten Students Enrolled by School Type	Percent of Students Who Have Received All School-Required Vaccines
District	36,480	78.5%	87.2%
Charter	7,156	15.4%	86.1%
Private	1,317	2.8%	86.2%
Online	1,531	2.9%	46.1%
Total	51,315	100%	87.1%

Source – Utah Department of Health and Human Services Immunization Program

Figure 3 illustrates the percentage of adequately vaccinated children by school district compared to the state average.

Figure 3
Kindergarteners Adequately Immunized in Utah by Public School District (2023-2024 School Year)



Source – Utah Department of Health and Human Services Immunization Program
No data for 9 districts that responded <100 kindergarteners

Table 5
*Utah Kindergarten Students/Schools with Required Vaccines In the 2023-24 School Year**

	Utah kindergarten schools/students with **all school required vaccines**			Utah kindergarten schools/students with adequate **measles vaccinations**		
Vaccination Level	Number of Schools	Percent of Total Schools	Percent of Kindergarten Students	Number of Schools	Percent of Total Schools	Percent of Kindergarten Students
Above 95%	115	15.8%	9.8%	193	26.5%	21.2%
Below 95%	613	84.2%	90.2%	535	73.5%	78.8%
Below 90%	428	58.8%	61.2%	305	42.6%	42.6%
Below 85%	254	34.9%	34.0%	154	19.5%	19.5%
Below 80%	137	18.8%	16.9%	80	9.4%	9.4%

Source—Utah Department of Health and Human Services—School Immunizations
**Note the measure above is the percentage of kindergarten students who provided documentation of receipt of all school-required vaccines. Students who are not adequately immunized may have a vaccine exemption, be conditionally enrolled, be out of compliance, or have proof of a history of disease.*

Fourteen school districts had vaccination rates equal to or exceeding the state average of 87.2 percent, with some approaching the optimal levels recommended by the CDC. Seventeen districts reported rates below the state average. Vaccination rates can vary significantly among schools within each district. Averages can differ within a given school district, and some schools achieve 100%. While some individual schools may be at high risk or even very high risk, assessing this is challenging without school-specific data.

Table 5 illustrates the number and percentage of schools and students with adequate vaccination levels at specific thresholds, enhancing understanding of transmission risks in Utah schools. Measles is included due to its high transmissibility; however, declining vaccination rates for Polio and DTaP have been similar. The lower the vaccination level, the greater the potential for an outbreak. This threshold varies by disease type: a lower percentage of vaccinated students increases the potential for disease transmission.

As noted in **Table 5,** only 15.8% of schools and 9.8% of students have adequate vaccination levels (above 95%) for all school-required vaccines. The measles vaccination rate is higher, with 26.5% of schools and 21.2% of students adequately vaccinated. Approximately 42% of schools in Utah have measles vaccination levels below 90% and are likely to experience an outbreak if an infected child enters the school. This poses a public health concern.

Why Have Vaccination Levels in Utah Schools Declined

There are several reasons why vaccination rates for children in Utah have declined. Public awareness of the severity of infectious diseases and the impact of vaccines on community health have diminished over time as these diseases have become less common.

Table 6
Utah Exemption Rates by School Type and School Year

School Type	2015-16	2021-22	2023-24
Public/ District	3.9%	5.2%	7.0%
Public/Charter	7.4%	9.5%	12.0%
Private	5.1%	5.9%	7.7%
Online	26.9%	31.3%	51.2%
Total	4.6%	6.6%	9.3%

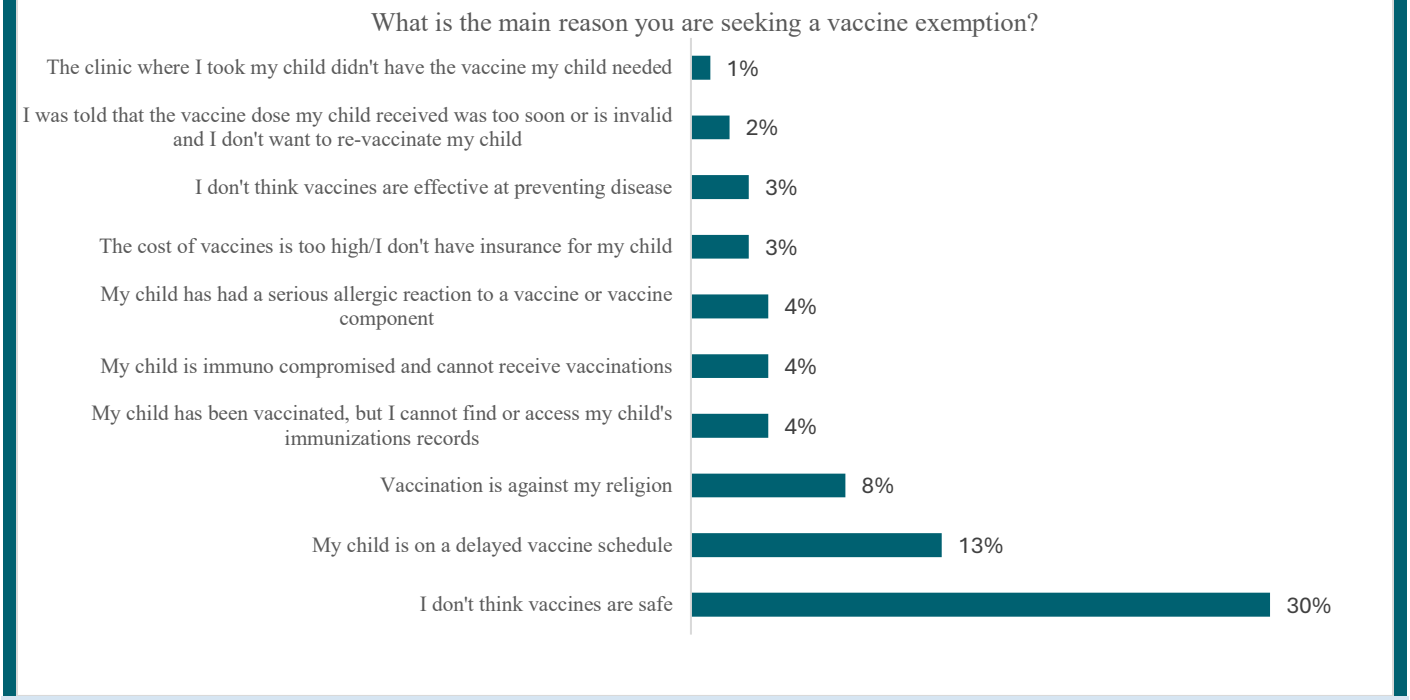
Source – Utah Department of Health and Human Services Immunization Program

Furthermore, the politicization of the pandemic led to a surge of misinformation and disinformation surrounding vaccines.[21] Studies show that communities with widespread vaccine misinformation have increased risks from vaccine-preventable diseases because misinformation can undermine public trust in vaccines.[22] Conversely, evidence indicates that accurate vaccine information correlates with higher immunization rates and fewer outbreaks.[23]

As a result, the state has seen an increase in parents seeking exemptions from vaccine requirements for school entry, as indicated in **Table 6**. Utah allows parents to request a school vaccine exemption under three categories: Medical, Religious, and Personal belief. Utah does not require any specific documentation regarding church or religious affiliation to apply for a religious exemption. Religious exemptions are the type that has seen a steady rise over the last decade, from 0.7% of exemptions in the 2017/2018 school year up to 12.5% of exemptions in the 2024/2025 school year. Most exemptions fall under the Personal category, which made up 84.6% of exemptions in 2024/2025, with just 2.9% of exemptions under the Medical category.

The Utah Department of Health and Human Services uses an optional online survey for those requesting exemptions to provide more information regarding their exemption. The results are subject to selection bias since not everyone completes the survey; however, they offer some insight into the motivations behind exemption requests, see **Figure 4**. While most requested exemptions are based on personal beliefs, there has been a significant rise in the number and percentage of religious exemptions since the 2018- 2019 school year. Vaccine safety seems to be a major concern.

Figure 4 – *Survey Response Findings for Utah Vaccine Exemptions*



Source – Utah Department of Health and Human Services
Of note, 24% of respondents to the question selected 'Other, please specify:' and provided a free text response summarizing their reasons for seeking a vaccine exemption. Those responses are not included in the bar chart.

As Vaccination Rates Decrease, How Infectious Diseases are Introduced to a Community

Measles is a highly infectious disease that can cross borders into countries with low vaccination rates. In 2023, an estimated 10.3 million people were infected with measles, resulting in outbreaks in every region of the world.[24] Measles continues to claim the lives of thousands of children in Congo.[25] Samoa experienced a measles outbreak in 2019, which led to 5,707 cases and 83 measles-related deaths. Recently, measles outbreaks in Texas and New Mexico among unvaccinated individuals underscore the need to address the issue of declining vaccination rates for children entering school.

Those who are not vaccinated may contract measles while traveling abroad and could infect others upon their return home. In 2019, 1,274 measles cases and 22 outbreaks were reported in the U.S. across 31 jurisdictions, threatening the country's measles elimination status.[26] Most cases (85%) occurred in under-immunized, close-knit communities.[27] The number of cases dropped in 2020.

More recently, from January 1, 2020, to March 2024, 338 confirmed cases were reported in 30 jurisdictions, with 40% resulting in hospitalization. Of the 338 cases, 91% were unvaccinated.[28] [29]

Clusters of unvaccinated individuals pose a risk to communities for large outbreaks. For example, in Ohio in 2022, there were 86 cases in a tight-knit community with 94% unvaccinated and 42% hospitalized.[30]

Most individuals contracting measles in the US traveled internationally or were in proximity to someone who did.[31]

Increases in measles cases are not the only concern; in 2024, there were over 32,000 cases of whooping cough (pertussis).[32] In California alone, the disease affected 2,000 people between January and October.[33] **Figure 5** summarizes the risks of measles outbreaks. As vaccination levels for childhood infectious diseases in Utah decline, especially in some school districts, and global measles cases rise, the risk of outbreaks increases. The risk even exists in highly vaccinated communities when there are clusters of unvaccinated people, as illustrated in **Figure 6**.

Figure 7 illustrates the rising number of measles cases in the United States since January 2023, based on the rash onset date. As of May 15th, 2025, there have been 1,024 cases reported across 31 jurisdictions—14 outbreaks (defined as three or more related cases) have been reported in 2025, with 92% confirmed cases associated with these outbreaks. Additionally, 96% of cases involved unvaccinated individuals or those with unknown vaccination status, and there have been 3 confirmed deaths.

Figure 5 – *Primary Factors for a Measles Outbreak*

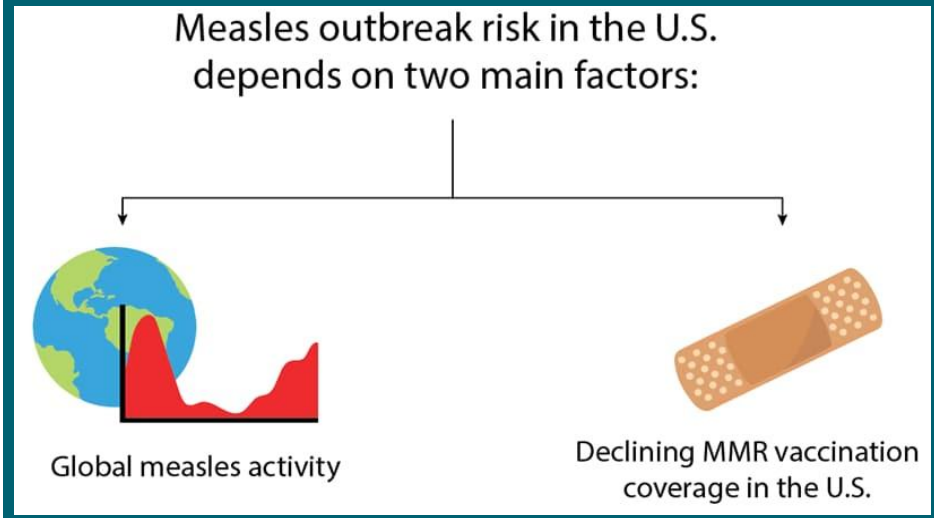
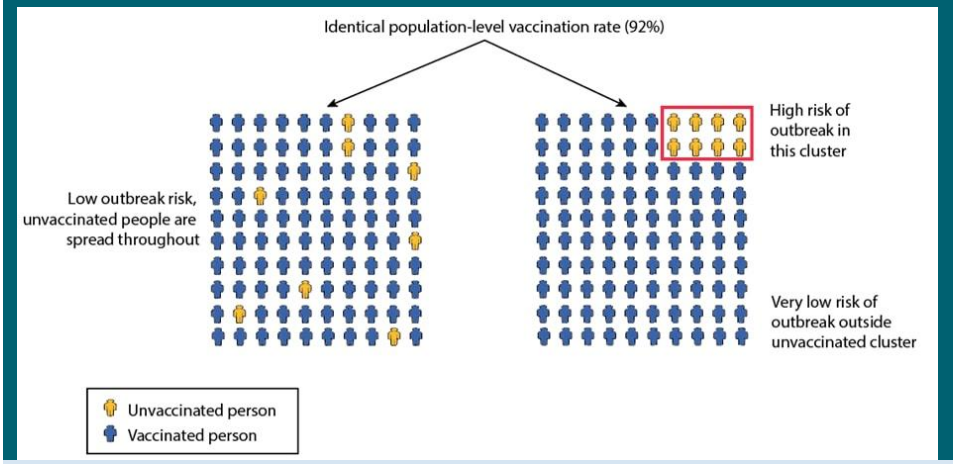
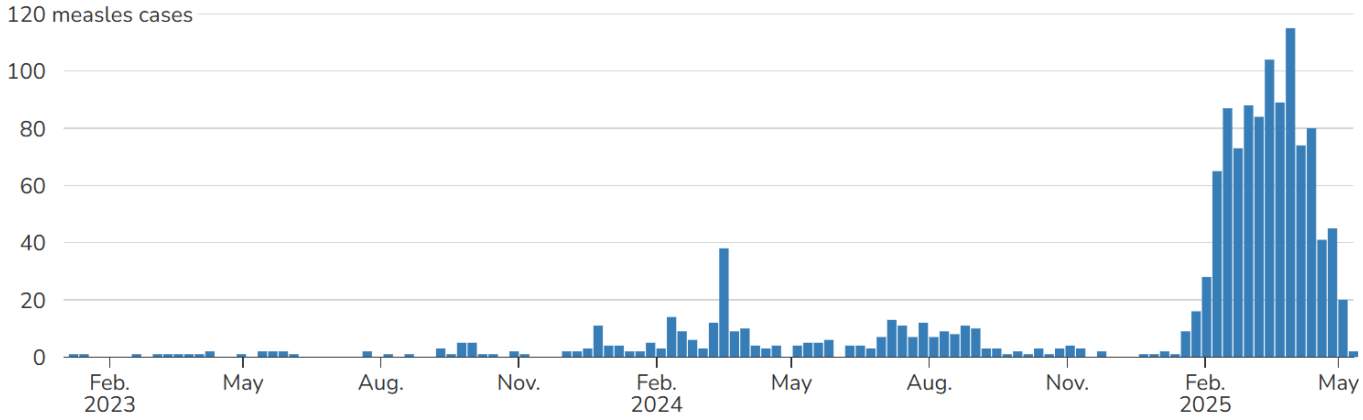


Figure 6 – *Impact of Community Clusters on Outbreak Risk*



Source for Figures 5 and 6 – Assessing Measles Outbreak Risk in the United States, cdc.gov

Figure 7
Weekly Measles Cases by Rash Onset Date
2023-2025 (as of May 15, 2025): case counts are preliminary and subject to change



Source – cdc.gov/measles/data-research/index.html

How Various Infectious Diseases Spread Through the Population

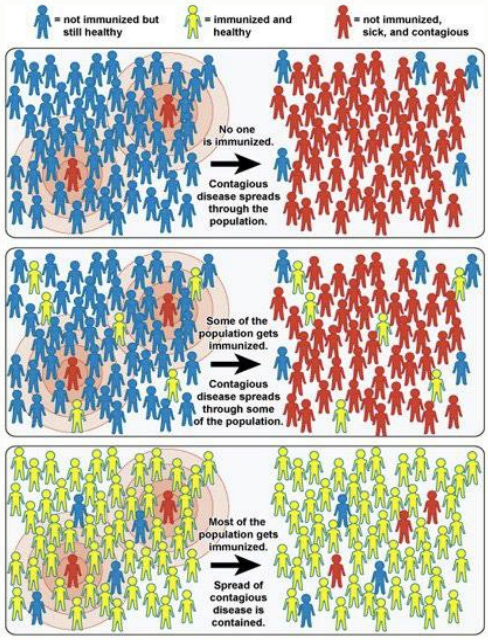
Table 7 *Infectious Disease Reproduction Numbers*	
Disease/Infection	The number of people infected by one person in an unvaccinated population
Diphtheria	6-7
Measles	12-18
Mumps	4-7
Pertussis	5-17
Polio	2-20 (5-17)
Rubella	6-7
Smallpox	5-17
Varicella	8-10
COVID (U.S.)[34]	3-4
Influenza	1.4-4
Source – Oxford Academic	

Infectious disease experts have studied and documented the spread of childhood infectious diseases in the population, as well as the effects of vaccines in preventing outbreaks and epidemics. In a fully susceptible (unvaccinated) population, infectious disease experts can estimate the number of secondary cases resulting from one infected person. This is known as the basic reproduction number (R_0). For example, if the R_0 for a specific pathogen is 4, the average infected person will transmit the infection to four others in an unvaccinated population. Each of these four individuals will then infect four additional people who will go on to infect others. The total number of infected individuals from a disease with an R_0 of 4 over five transmission cycles would be 1,364. The higher the R_0, the greater the expected number of cases.[35] As shown in **Table 7**, some disease pathogens are highly transmissible, while others exhibit lower transmission rates.[36]

VACCINE LEVELS & THE SPREAD OF DISEASE

There is a connection between vaccination rates and disease spread when an infected individual enters a community. **Figure 8** illustrates the dissemination of an infection in a homogeneous community with varying levels of immunity. In a highly vaccinated population, protection against infection occurs in two ways: the vaccinated individual is shielded, and the community benefits from a significant reduction in person-to-person transmission of the disease.

Figure 8 – *The Impact of Community Immunization Levels on the Spread of Disease*



Source – The National Institute of Allergy and Infectious Disease (NIAID)

It is essential to emphasize that *community protection is critical for non-immune individuals who cannot be vaccinated, as they rely on high levels of vaccination coverage in the community to safeguard against infectious diseases. These individuals include infants too young to be vaccinated, pregnant women, the elderly, and those with compromised immune systems due to conditions such as cancer.* The safe and ethical method to achieving both individual and community immunity is through widespread vaccinations, a practice that the U.S. has endorsed since the early 1950s.

Vaccine Threshold for Achieving Individual & Community Immunity

Herd immunity has traditionally referred to the point at which enough individuals are immune to a virus, allowing social distancing to reduce transmission and preventing healthcare systems from becoming overwhelmed. Some experts argue that the term is no longer helpful and can be misleading. Most epidemiologists now define the concept as "the proportion of people in a

community who need to be immune for infection rates to decline." [37] This means that, statistically, the virus will spread to fewer than one person in a group, causing it to fizzle out. This is termed *Community Immunity or Protection.*

Table 8
Percent Immunity Threshold by Disease

Disease/Infection	Percent Immunity Threshold for Controlling Transmission
Diphtheria	83-85 %
Measles	93-94 %
Mumps	75-86 %
Pertussis	80-94%
Polio	50-95%
Rubella	83-85%
Smallpox	80-85%

Source – Oxford Academic

Infection rates can vary significantly among different populations due to several factors, including the number of individuals who are naturally immune and those who have acquired immunity through vaccination. This threshold is depicted in **Table 8**.[38] As shown, our schools and communities must maintain relatively high vaccination levels to achieve both individual and community immunity. Unfortunately, the average vaccination rates for many schools fall well below the necessary threshold for measles immunity and are below the thresholds for other childhood infectious diseases.

Individual Immunity and the Transmission Rate of Infectious Diseases

Community and individual immunity can vary based on the number of immune individuals in a population, as shown in **Table 9**. This number may fluctuate depending on the homogeneity of the population, the number of people with natural immunity, and the percentage of those who are vaccinated.[39]

Table 9
The Impact of Population Immunity on Disease Cases

Proportion of the population with immunity (%)	The number of people infected by a single person (R_0)	Number of projected cases			
		1st Transmission Cycle	2nd Transmission Cycle	3rd Transmission Cycle	4th Transmission Cycle
0	4	4	16	64	256
25	3	3	9	27	81
50	2	2	4	8	16
75	1	1	1	1	1
100	0	0	0	0	0

Source – Oxford Academic
This table is intended to provide a conceptual understanding of the relationship between immunity and infection rates. The projections assume an infinite homogenous population with a complete mixing of cases among the remaining population. These assumptions will not be sustained in a real-world setting.

Example: How Measles Can Spread When 1 Infected Person Enters a School with 100 Students

Table 10
Theoretical Measles Outbreak by Vaccination Level in a School with 100 Students

Percent of students with MMR vaccination	Number of children susceptible	Chance of an outbreak
97%	6	16%
95%	8	29%
93%	10	36%
90%	13	51%
85%	18	61%
80%	22	64%
70%	32	78%

Source – Assessing Measles Outbreak Risk in the United States NCIRD, CDC

Based on studies related to measles transmission,[40] **Table 10** presents an example of a school with 100 children, including one infected child, at varying levels of MMR coverage. The model assumes that the child with measles attends school while infectious without any vaccine intervention.[41] [42]

As vaccination coverage declines, the likelihood of an outbreak rises. An outbreak becomes more likely once MMR coverage falls to 90% or lower. 305 schools in Utah have measles vaccination rates below 90%. Despite achieving 97% coverage, an outbreak remains possible if a child attends school while infected. Given that measles is highly contagious, unvaccinated children face a risk of contracting the virus. There may be an even greater risk within specific schools in a district, particularly in those with low vaccination rates.

Transmission of Infectious Disease for Fully or Partially Immunized

Can a fully vaccinated person infected with a childhood infectious disease, such as measles, transmit the disease to others? Can a partially or fully immunized child still spread an infection to another person?

Being vaccinated doesn't prevent the virus from entering the body. However, it enables the body to initiate a rapid immune response and prevents most individuals from becoming sick. Therefore, even vaccinated people can carry and shed small amounts of the virus in a brief period. Onward transmission, or spreading the virus to others, is known to occur among individuals who are partially or fully vaccinated against measles. Nevertheless, many studies conclude that this happens at a much lower rate compared to those who are unvaccinated.

The CDC has concluded, "Vaccinated individuals appear less likely to transmit the disease to others, including those who are too young to be vaccinated or have weakened immune systems."[43]

IMPACT OF ELIMINATING VACCINE REQUIREMENTS FOR SCHOOL ENTRY & THE MARKET DRIVING OPTIONAL VACCINE UPTAKE

Some oppose vaccine requirements for school entry, arguing that if parents are concerned about their child contracting a vaccine-preventable illness like polio or measles, they can choose to vaccinate their child, ensuring protection. If a parent opts not to vaccinate one of their children, that child may become infected, but this remains the parent's choice and does not impact others because vaccinated individuals are still protected. Thus, we should allow the "market" to naturally regulate vaccine uptake.

But the decision about whether to get vaccinated impacts more than just the individual. Children who contract vaccine-preventable illnesses such as measles, mumps, and whooping cough may begin with symptoms resembling a cold and could infect their classmates, grandparents, or strangers in the grocery store before showing the classic signs of those diseases. *It is essential to remember that community protection is vital for non-immune individuals who cannot receive vaccinations, as they rely on high levels of vaccination coverage in the community to safeguard against infectious diseases. These individuals include infants who are too young to be vaccinated, pregnant women, the elderly, and those with compromised immune systems due to conditions such as cancer.*

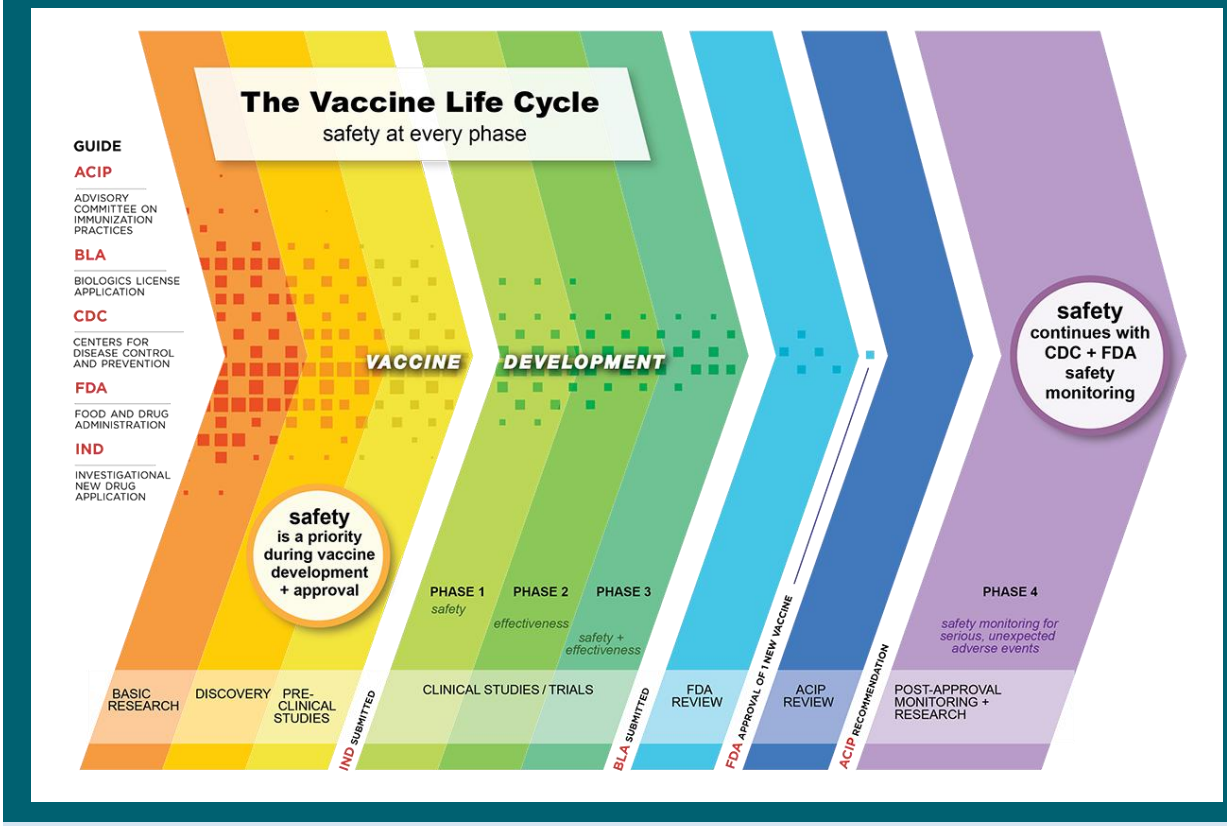
Before vaccines, children with polio were placed in iron lungs for months, community swimming pools were closed to prevent transmission, boys were rendered sterile by mumps, and babies choked to death from whooping cough. Vaccines were viewed as a miracle, and families hurried to have their children immunized. Nowadays, few families even know about, let alone fear, those tragic scenarios. Thus, the market for childhood vaccines does not operate on standard market principles. By the time parents perceive the product as valuable, it is often too late to benefit from it. Furthermore, like driving under the influence or smoking in public places, the consequences of individual vaccination decisions extend beyond the individual alone.

Parents have indicated that their primary reason for not vaccinating their children is concern about safety. Questions arise regarding vaccine safety, particularly since many are required. The amount of material injected into children raises worries about the long-term implications. Additionally, there are concerns about the adequacy of clinical trials and the potential connection between vaccines and chronic illnesses. The following paragraphs will discuss how vaccine safety is ensured, the side effects of vaccinations, and how the benefits of vaccinations outweigh the risks.

1. What is the process for validating the safety and effectiveness of vaccines?

Vaccines were developed to prevent life-threatening infectious diseases and are estimated to have saved over 150 million lives worldwide in the past 50 years.[44] Most vaccines have been in use for decades, with millions of people safely receiving them each year. Like any other medicine, vaccines must undergo rigorous testing to ensure their safety and effectiveness before being administered to the general population. The vaccine development process involves many steps, summarized in **Figure 9** below.

Figure 9
Vaccine Development Process



Source – How Vaccines are Developed and Approved for Use, cdc.gov

Vaccines are first tested in animals to ensure they are safe and create a response in the immune system. Next, they go through 3 phases of human testing:

Phase 1	The vaccine is given to a **small amount of healthy, adult volunteers** to ensure the vaccine is safe and creates an adequate immune response.
Phase 2	The vaccine is administered to **several hundred volunteers** to confirm its safety and stimulate the desired immune response. It is typically tested in specific populations for whom the vaccine is intended, such as individuals of a certain age or gender.
Phase 3	The vaccine is given to **thousands of volunteers,** again ensuring it is safe for people and effective at preventing the infection.

2. Is there an adequate system to monitor vaccine safety after they have been approved?

The CDC and FDA continue to closely monitor vaccine safety after approval through four complementary systems that provide data to the Immunization Safety Office: The Vaccine Adverse Event Reporting System (VAERS), the Vaccine Safety Datalink (VSD), the Clinical Immunization Safety Assessment (CISA) project, and V-safe. Additionally, they utilize several other governmental and nongovernmental programs to monitor vaccine safety.

3. What has been the history of adverse reactions to required vaccines?

Like any medication, vaccinations can also lead to adverse reactions. The most common side effects include pain at the injection site, muscle aches, and fevers, which occur when the body's immune system is activated to protect against disease. While these side effects may be uncomfortable, they are temporary and not dangerous.

As millions of children have received required vaccinations over the past decades, they are among the most studied medications available. Scientists and doctors have thoroughly evaluated potential rare side effects associated with vaccinations. In 2021, the Agency for Healthcare Research and Quality (AHRQ) published a 1,340-page document summarizing the results of hundreds of rigorous studies assessing vaccination safety.[45] They concluded that there is enough evidence indicating that the following rare adverse effects may occur:

Table 11
Summary of Rare Adverse Vaccine Effects

Adverse effect	Vaccine	Risk	Outcome
Febrile seizures	MMR 13-valent PCV	1 in ~1,500 1 in ~3,500	Febrile seizures are common in children and usually resolve on their own, do not require treatment, and do not cause any harmful long-term effects.[46]
Anaphylaxis	Several vaccinations	1 in ~700,000	Anaphylaxis is a severe allergic reaction and can be life threatening without treatment. Most cases of anaphylaxis happen quickly, and the condition resolves with the right treatment.[47]
Immune thrombocytopenic purpura	MMR Hepatitis A Varicella	1 in ~40,000	Immune thrombocytopenic purpura is a condition where the body destroys its own platelets, which increases the risk of bleeding. It is usually short term, and most children do not experience bleeding episodes or have any long-term complications. It sometimes requires treatment with platelets or medicines to stop the immune system reaction.[48]

Source – Compiled from various sources that are indicated in the endnotes

4. What other notable concerns related to vaccine safety have been identified?

Many other conditions have been evaluated as potential side effects but have not been linked to vaccinations; some of these are addressed below.

Do childhood vaccines cause autism and other chronic diseases?

Autism is often diagnosed around the same time that children receive routine vaccinations. This coincidence has led to concerns and misinformation that have affected attitudes toward child vaccination. Perhaps most famously, it was suggested that autism is associated with the MMR vaccine based on data published in the 1990s. This study was found to be based on false and manipulated data; it was retracted from the journal, and the author was discredited and removed from the United Kingdom health register. Over the last two decades, credible scientists have conducted extensive research worldwide to investigate the link between childhood vaccinations and autism. Despite a wealth of evidence disproving this connection, [49] [50] [51] the myth persists among many. The results of the research are clear - vaccines do not cause autism.[52]

Have vaccines increased the incidence of chronic diseases?

Concerns have been raised that as vaccines have been introduced into society, there has been a corresponding increase in chronic diseases. There is an assumption that when two things occur simultaneously, they are related. While this may be true in some cases, it is not in many others. For example, ice cream consumption and shark attacks both increase every

summer and decrease in winter. Despite this, it would be incorrect to conclude that eating ice cream causes shark attacks. The more likely explanation is that more people consume ice cream and go into the ocean when the weather is warm. This is the case with vaccines and chronic diseases. The immune system has the same response whether it is exposed to a natural infection or a vaccination.[53]

The notion that increased vaccines have led to more chronic diseases is a hypothesis tested in numerous studies, and no evidence supports it. A meta-analysis of 144 studies published over 50 years found that autoimmune diseases occur at the same rate in vaccinated and unvaccinated individuals.[54] Unfortunately, some people persist in spreading the claim that vaccines cause chronic diseases. They rely on incorrect or partial explanations of basic science, refer to poorly constructed or disproven studies, dismiss research that contradicts their viewpoint, and employ logical fallacies. Additionally, they often suggest cover-ups and expansive conspiracies.[55] Despite this, extensive research demonstrates that vaccinations are safe and not linked to chronic illness.

Have the vaccines used for childhood infectious diseases gone through complete clinical trials?

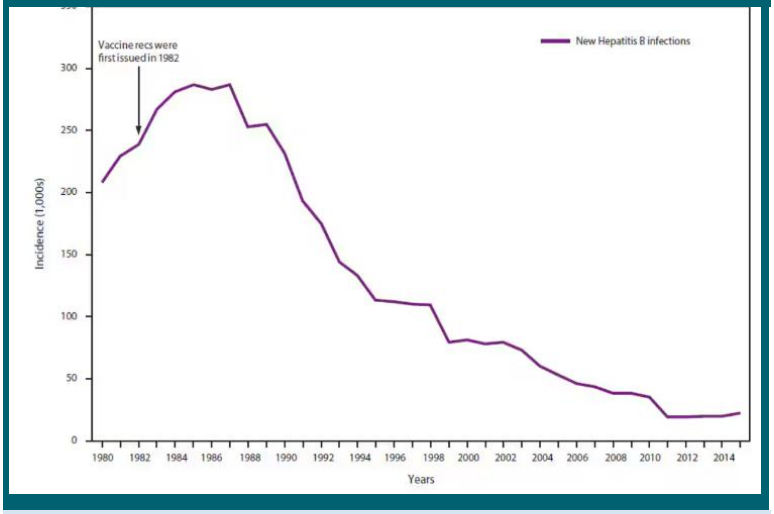
A long-term placebo-controlled trial is a research study in which participants are randomly assigned to receive either an experimental treatment or a placebo for an extended period. The placebo is typically an inert substance, often, though not always, a saline solution. The Informed Consent Action Network (ICAN) has claimed that 17 vaccines were not licensed by the U.S. Food and Drug Administration based on a long-term placebo-controlled trial, including vaccines for whooping cough, measles, mumps, and rubella. This claim is misleading.[56] ICAN's definition of placebo is overly narrow and inaccurate. In some studies, a non-placebo is utilized for the control group due to ethical considerations.

For example, some vaccines may have been tested against older vaccines instead of a placebo. This does not mean they skipped clinical trials. It means that randomizing an infant or child to receive a placebo would be unethical, as it would put them at risk of life-threatening illness when a vaccine already exists that has been proven safe and effective. **Perhaps the most compelling truth is that vaccines for childhood infectious diseases have been around for generations and have been safely administered to millions of children. Contrary to what some may claim, the fact remains that childhood vaccinations have undergone extensive clinical trials before public use.**

5. What is the risk/benefit relationship of childhood vaccines?

As with any medical treatment, the risks and benefits of immunizations have been carefully considered, and the benefits of immunization consistently far outweigh the potential risks. Once-deadly diseases like diphtheria and polio have essentially vanished in the United States, thanks to immunizations. Also, thanks to *Haemophilus influenzae,* fewer children are disabled or dying from invasive meningitis, which used to kill 20,000 children yearly and is now virtually eliminated. Maintaining population measles immunity helps prevent measles outbreaks, which can be catastrophic and quickly overwhelm local hospitals due to its ability to spread rapidly between people, as evidenced by the recent outbreak in West Texas, which killed the first American child in over 20 years.[57]

Figure 10
Incidence of Hepatitis B virus infection in the United States, 1980-2015



Source – National Notifiable Diseases Surveillance System

To understand the benefits of vaccinations, examining each one individually is helpful. For instance, when the hepatitis B vaccine was developed in the 1980s, approximately 2 million Americans were infected with hepatitis B, including 18,000 newly infected children each year. About 1 in 4 individuals with chronic disease developed liver cirrhosis, leading to around 1,700 deaths annually. It is widely accepted that the advantages of hepatitis B vaccination, which has significantly reduced the prevalence of this disease and its complications,[58] far outweigh the risks, including a self-resolving skin reaction and the risk of anaphylaxis (1 in about 700,000). Similar risk/benefit comparisons are presented in **Table 12**.

Table 12 *Summary of Vaccine Risks and Benefits*		
Vaccine	Vaccine Side Effects	Risk of Disease Without Vaccine
Measles (MMR)	• Fever (1 in 10) • Rash (1 in 20) • Swollen lymph nodes (1 in 20) • Joint pain (1 in 200) • Immune thrombocytopenic purpura (1 in 40,000) • Febrile seizure (1 in 1,500) • Anaphylaxis (1 in 700,000)	• Death (1 in 1,000) • Encephalitis (1 in 1,000) • Pneumonia (1 in 20) • Hospitalization (20-50%) • Immune thrombocytopenic purpura (1 in 20,000) • Subacute sclerosing panencephalitis (1 in ~1,300). Occurs 7-10 years after measles infection; many cases are fatal[59]
Polio (IPV)	• Fever (1 in 30) • Pain, redness, swelling at injection site (rare)	• Irreversible paralysis in 1/200 infections [60] • Post polio syndrome (1 in 2); Progressive muscle weakness with functional deterioration; Occurs decades after initial infection
Pneumococcal disease	• Pain, redness, swelling at injection site (1 in 5) • Fever (1 in 7) • Febrile seizure (1 in 3,500)	• 80% more likely to have sepsis or meningitis • Twice as likely to be hospitalized for pneumonia
Pertussis (DTaP) (Whooping Cough)	• Pain, redness, swelling at injection site (1 in 4) • Low grade fever, headache, nausea (1 in 4) • Increased fussiness (1 in 3)	• Death (1 in 100 infants) • Hospitalization; all infants < 4 months; 1 in 3 infants < 1 years old • Apnea (stop breathing, 1 in 4 infants) • Pneumonia (1 in 5 infants) • Seizures (1 in 50 infants) • Encephalopathy (1 in 150 infants)
Hemophilus meningitis (Hib)	• Sore infection site or fever (1 in 50)	• Death (1 in 20)[61] • Permanent disability (1 in 6) • Hospitalization (100%)
Varicella [62] (Chicken Pox)	• Pain, swelling at infection site (1 in 5) [63] • Fever (1 in 10) • Rash (1 in 30) • Immune thrombocytopenic purpura (1 in 40,000)	• Hospitalization (1 in 250) • If spreads to infant, can cause meningitis or death • If spreads to pregnant woman, can cause serious birth defects • Shingles later in life (1 in 10)
Hepatitis A	• Pain, redness, swelling at injection site (1 in 3)[64] • Fatigue, headache (1 in 15) • Immune thrombocytopenic purpura (1 in 40,000)	• Hospitalization [65](1 in 3 older children) • Liver failure (<1 in 100) • Death (1 in 300)
Source – Compiled from various sources that are indicated in the endnotes		

6. How do the risks of vaccine-related adverse events compare to those from other drugs?

The risk of adverse events from vaccination is comparable, if not lower, than that of other commonly used medications. Antibiotics are frequently prescribed to children for bacterial infections, such as ear infections, strep throat, or pneumonia,

with tens of millions administered to children each year in the US.[66] While these medications can be lifesaving, they also carry the risk of adverse side effects, much like vaccinations.

Amoxicillin, for example, is one of the most prescribed medications in children and has many potential side effects including allergy (~1%), anaphylaxis (1 in ~300)[67] serum-sickness-like reactions (1 in thousands), Clostridium difficile infection, and, in rare cases, a life-threatening immune reaction known as Stevens-Johnson syndrome. In summary, although vaccinations may have possible adverse events, the fact that they have similar, if not lower, rates of adverse events compared to antibiotics suggests that they are also reasonable to administer.

VACCINE INJURY COMPENSATION PROGRAM

In the 1980s, the rising costs of defending against an increasing number of unfounded injury lawsuits prompted pharmaceutical companies to shut down their childhood vaccine production divisions. In 1986, Congress established the no-fault Vaccine Injury Compensation Program (VCIP) to review these claims and provide compensation to those whose vaccine-related complications were backed by the CDC's vaccine monitoring data and scientific research.[68] (COVID-19 vaccine claims are handled by a different program). Denials of compensation can be appealed to a special master and subsequently to federal courts. To date, there have been 25,000 claims, with half of them compensated for a total of $5.3 billion. This amounts to one compensated injury for every 1 million doses of vaccine distributed.

CONCLUSIONS

Childhood infectious diseases posed a significant public health problem in the early to mid-1900s, impacting nearly every household in America. The introduction of vaccines has virtually eliminated these diseases and is regarded as one of the most important achievements in the history of medicine and public health. Since 1974, vaccination has prevented 154 million deaths, including 146 million among children under five years old, with 101 million being infants younger than one year. For children born in the US from 1994 to 2023, routine childhood vaccinations prevented approximately 508 million cases of illness, 32 million hospitalizations, and 1,129,000 deaths.

Historically, Utah has achieved a high vaccination rate for children entering kindergarten, resulting in excellent community and individual protection against disease outbreaks. This success stems from strong parental support and school immunization requirements.

Despite the well-documented benefits of vaccines in preventing illness and death, measles vaccination rates for Utah children entering kindergarten have fallen below 90%, significantly lower than the 95% target recommended by the Centers for Disease Control and Prevention. This situation poses a risk of a measles outbreak in several schools in Utah.

The decline in vaccinations is because an increasing number of parents are requesting vaccine exemptions for their children. The increase in exemptions is associated with misinformation about vaccines and parental concerns regarding their safety. As with any medical treatment, the risks and benefits of immunizations have been carefully considered, and the benefits of immunization consistently far outweigh the potential risks. The risk of adverse events from vaccination is comparable, if not lower, than that of other commonly used medications.

Efforts should be made to provide credible, accurate, and trustworthy information on the benefits and risks of vaccines for children to policymakers, parents, healthcare providers, and the general public.

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Appendix A – Participants in the Study Forum

The participants in the study forum who contributed to this document include the following individuals:

Michael J. Stapley, MPA *Study Forum Chair*	Utah Citizens' Counsel; retired President and Chief Executive Officer, Deseret Mutual; former Deputy Director and Interim Executive Director, Utah Department of Health
Caitlin Schneider, MPH	Senior Partnership Director, Promise Partnership Utah; former Chief Public Health Officer, East Central District Health Department in Nebraska
Ciriac Alvarez Valle	Senior Policy Analyst, Voices for Utah Children
Scott Williams, MD, MPH	Pediatrician; former faculty member, University of Utah College of Medicine; former Executive Director, Utah Department of Health
William Cosgrove, MD	Pediatrician; representative of the Utah Chapter of the American Academy of Pediatrics
Neal Davis, MD	Pediatrician; Medical Director, Pediatric Program Intermountain Health
Nathan Money, DO	Assistant Professor, University of Utah School of Medicine, Primary Children's Hospital
Jason R. Hoagland, MD	Pediatrician, Tanner Clinic; Representative Utah Medical Association
Noel C. Nye, DO	Pediatrician, Tanner Clinic; Representative Utah Medical Association; Past President Utah Medical Association
Gary Edwards, MPH	Former Director of the Salt Lake County Health Department; current advisor to the Association of Local Health Officers
Rich Lakin, MSPH, MPA	Immunization Program Manager, Utah Department of Health and Human Services
Robert Huefner, DBA	Utah Citizens' Counsel; Emeritus Professor of Political Science and Director Matheson Center for Health Policy, University of Utah
Wu Xu, PhD	Utah Citizens' Counsel; retired Director of the Center for Health Data and Informatics, Utah Department of Health
Tamara Sheffield, MD, MPA, MPH	Medical Director, Immunization Programs, Intermountain Health
Carole Stipelman, MD, MPH	Professor of Pediatrics and Informaticist, University of Utah; Child Population Health Researcher, Intermountain Health
Whitney Stephens, MA	Partnership Director, Promise Partnership Utah
Jessica Payne, MPH	Lead Epidemiologist, Utah Department of Health and Human Services, Immunization Program